2013-2014 LONG SIGNATURE SHEET

RECEIVED 10/10/13

Revised
RECEIVED 10/29/13

UNC CHARLOTTE

Proposal Number: MATH 10-10-13

Proposal Title: Major Changes to PHD-MAAP Program of Study

Originating Department: Mathematics and Statistics

TYPE OF PROPOSAL: UNDERGRADUATE_____ GRADUATE √ UNDERGRADUATE & GRADUATE___
(Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVE	DATE CONSIDERED	DATE FORWARDED	ACTION	SIGNATURES
10/10/2013	10/10/2013	10/10/2013	Approved	**DEPARTMENT CHAIR** Yuanan Diao
			Approved 10/25/13	**COLLEGE CURRICULUM COMMITTEE CHAIR** Oscar Lansen
			Approved 11/01/13	**COLLEGE FACULTY CHAIR (if applicable)** [print name here:] Michael Turner
11/1/13	11/1/13		Approved	**COLLEGE DEAN** [print name here:] GBrody
			Approved	**GENERAL EDUCATION** (if applicable; for General Education courses) [print name here:]
			Approved	**UNDERGRADUATE COURSE & CURRICULUM COMMITTEE CHAIR** (for undergraduate courses only)
11/5/13	12/3/13	12-20-13	Approved	**GRADUATE COUNCIL CHAIR** (for graduate courses only) ALAN R. FREITAG
12/20/13				**FACULTY GOVERNANCE ASSISTANT** (Faculty Council approval on Consent Calendar)
				FACULTY EXECUTIVE COMMITTEE (if decision is appealed)

2013-2014 LONG SIGNATURE SHEET

Proposal Number: _____MATH 10-10-13_____

Proposal Title: ___Major Changes to PHD-MAAP Program of Study_____

Originating Department: ___Mathematics and Statistics_____

TYPE OF PROPOSAL: UNDERGRADUATE_____   GRADUATE__**X**____   UNDERGRADUATE & GRADUATE____
(Separate proposals sent to UCCC and Grad. Council)

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10/10/2013	10/10/2013	10/10/2013	*Approved*	**DEPARTMENT CHAIR** Yuanan Diao
			Approved	**COLLEGE CURRICULUM COMMITTEE CHAIR** [print name here:]
			Approved	**COLLEGE FACULTY CHAIR (if applicable)** [print name here:]
			Approved	**COLLEGE DEAN** [print name here:]
			Approved	**GENERAL EDUCATION** (if applicable; for General Education courses) [print name here:]
			Approved	**UNDERGRADUATE COURSE & CURRICULUM COMMITTEE CHAIR (**for undergraduate courses only)
			Approved	**GRADUATE COUNCIL CHAIR** (for graduate courses only)
				FACULTY GOVERNANCE ASSISTANT (Faculty Council approval on Consent Calendar)
				FACULTY EXECUTIVE COMMITTEE (if decision is appealed)

Revised 10/11/13
OAA/mjw

UNC CHARLOTTE

LONG FORM
COURSE AND CURRICULUM PROPOSAL

*To: College of Liberal Arts and Sciences Graduate Council

From: Department of Mathematics and Statistics

Date: October 10, 2013

Re: Major Changes to PHD-MAAP Program of Study

The Long Form is used for major curriculum changes. Examples of major changes can include: creation of a new major, creation of a new minor, creation of a new area of concentration, or significant changes (more than 50%) to an existing program (Note: changing the name of an academic department does not automatically change the name(s) of the degree(s). The requests must be underline approved underline separately by the Board of Governors.)

Submission of this Long Form indicates review and assessment of the proposed curriculum changes at the department and collegiate level either separately or as part of ongoing assessment efforts.

**Proposals for undergraduate courses should be sent to the Undergraduate Course and Curriculum Committee Chair. Proposals related to both undergraduate and graduate courses, (e.g., courses co-listed at both levels) must be sent to both the Undergraduate Course and Curriculum Committee and the Graduate Council.

University of North Carolina at Charlotte

Revised Graduate Program of Study

Proposal from: Department of Mathematics and Statistics

Title: **Major Changes to Ph.D. in Applied Mathematics Program of Study**

II. CONTENT OF PROPOSAL

A. PROPOSAL SUMMARY

1. **PROPOSAL SUMMARY**

   The Department of Mathematics and Statistics proposes the following major changes to the Doctor of Philosophy Degree in Applied Mathematics (PHD-MAAP) Program.

   1.1. Rename the current preliminary examination so that it is now our qualifying examination, namely, change the section title "Preliminary Examination" to "Qualifying Examination".

   1.2. Replace the current comprehensive oral qualifying examination by a dissertation topic proposal defense, namely, replace the "Qualifying Examination and Admission to Candidacy" section and its content as follows:

   From: Qualifying Examination and Admission to Candidacy

   Each student must pass a comprehensive oral examination covering her/his chosen field of research and related advanced coursework. The exam is conducted by the student's Advisory Committee and may include an additional written examination. The exam is open to the graduate faculty of the department. The student is expected to take the qualifying examination within two years of the appointment of the student's Advisory Committee. A student who fails the qualifying examination twice is terminated from the Ph.D. program. The dissertation topic may be proposed after the student has passed the qualifying examination. A doctoral student advances to candidacy after the dissertation topic has been approved by the student's advisory committee and the Dean of the Graduate School.

   To: Topic Approval Defense and Admission to Candidacy

   After the student completes the qualifying examination and advanced coursework deemed necessary for the student's research as approved by the student's doctoral dissertation committee, the student, in consultation with the student's dissertation

advisor, may propose a dissertation topic. The dissertation topic proposal must be articulated and defended at a meeting of the student's doctoral dissertation committee. A written dissertation proposal must be submitted to the dissertation committee at least two weeks prior to the scheduled defense. The student is expected during the course of the topic defense to outline and demonstrate sufficient proficiency with the advanced knowledge and techniques to be used in the conduct of the research. The topic approval defense and the committee's deliberations in this regard are to be conducted according to the pertinent regulations of the Graduate School. A doctoral student advances to candidacy after the student's dissertation committee and the Dean of the Graduate School approve his/her dissertation topic proposal.

1.3. Remove the entire "Language and Research Tool Requirements" section.

The following minor changes are also proposed to the same program.

1.4. Clarify the program core courses in "Program of Study" section:

From: The student must complete an approved program of study, including a minor, typically including approximately 54 credit hours.

To: The student must complete an approved program of study, including MATH 8143/8144 and a minor, typically including approximately 54 credit hours.

1.5. Add the following statement into the new "Qualifying Examination" section:

After being admitted to the Ph.D. program, a student is expected to take the qualifying examination within three semesters. This time limit may be extended for up to two additional semesters in certain cases, depending on the background of the student and with program approval.

1.6. Modify the description of the qualifying examination in the new "Qualifying Examination" section:

From: The examination consists of two parts: a written examination based on Real Analysis I and II (8143-8144) and a written examination based on two other related courses chosen by the student and approved by the department Graduate Committee.

To: The qualifying examination consists of two parts: the first part is a written examination based on Real Analysis I and II (MATH 8143-MATH 8144) or Probability Theory I and Real Analysis I (MATH 8120-MATH 8143), the latter intended for a student with a statistics focus. The second part is a written examination based on two other courses chosen by the student to be specifically related to the student's intended specialty and approved by the department Graduate Committee.

1.7. Add the following course descriptions:

STAT 8110. Applied Biostatistics: Regression. (3) See HSRD 8110 for Course Description.

STAT 8111. Applied Biostatistics: Multivariate Methods. (3) See HSRD 8111 for Course Description.

In addition, the revised catalog should correct the following editorial typos.

From: **MATH 8050. Topics in Mathematics. (2-3)** See MATH 7071 for Course Description.

To: **MATH 8050. Topics in Mathematics. (2-3)** See MATH 7050 for Course Description.

From: **MATH 8144. Real Analysis II. (3)** See MATH 7147 for Course Description.

To: **MATH 8144. Real Analysis II. (3)** See MATH 7144 for Course Description.

From: **MATH 8275. Dynamical Systems I. (3)** See MATH 7276 for Course Description.

To: **MATH 8275. Dynamical Systems I. (3)** See MATH 7275 for Course Description.

B. JUSTIFICATION

1. Identify the need addressed by the proposal and explain how the proposed action meets the need.

In the academic year of 2012-2013, the Graduate Curriculum Committee in the Department of Mathematics and Statistics at UNC Charlotte carefully reviewed its Doctor of Philosophy Degree in Applied Mathematics program, including the current catalog and the past program performance, and identified the following closely related issues.

a. Revision to the exam structure: The University Graduate Catalog states that "all candidates for doctoral degrees must satisfy all University degree requirements in addition to all standards established by the doctoral faculty of their particular program." As detailed in the "Ph.D. Degree Requirements" section of the current 2013-2014 graduate catalog (pages 68-70), these University degree requirements include, among many others, a qualifying examination, a defense of the dissertation topic proposal, and a final examination over the contents of the dissertation (dissertation defense). The current corresponding Department requirements as specified in the "Ph.D. in Applied Mathematics" section of the current 2013-2014 graduate catalog (pages 509-510), however, include a written preliminary examination of core coursework, a comprehensive oral qualifying examination of advanced coursework, and a final dissertation defense. While it is generally expected that the comprehensive oral qualifying examination shall cover, and the advanced coursework to be examined shall

be related to, a student's chosen field of research, the important Dissertation Topic Proposal Defense component is missing from the current Department requirements. As such, we propose to replace the current comprehensive oral qualifying examination by a dissertation topic proposal defense and rename the current preliminary examination so that it is now our qualifying examination. We believe that the proposed changes as summarized in 1.1 and 1.2 together make our exam structure more consistent with the university one for doctoral students.

b. **Revision to qualifying examination:** The current 2013-2014 University Graduate Catalog (page 69) requires that "Each student must complete a qualifying examination. Ordinarily students who enter a Ph.D. program directly from a baccalaureate program sit for this examination before the end of their third post-baccalaureate year in the program while students who enter a Ph.D. program from a master's degree program take the examination before the end of their first year in the doctoral program." In our department, however, the majority of our Ph.D. students who enter the program directly from a baccalaureate program sit for our current oral qualifying examination in their fourth or even fifth year in the program, while our students who enter the program from a master's degree program take the examination in their third or fourth year in the program. The revised timeline of our new qualifying examination, as proposed in 1.1 and 1.5, is now in line with the university requirement.

The current comprehensive oral qualifying examination of advanced coursework is designed to determine if a student has attained the necessary knowledge and skills for success in the Ph.D. program and serve as the gateway for advancing to the Ph.D. candidacy. The issues are that quite often some advanced coursework examined were not related to a student's chosen field of research and that it is difficult to judge the student's potential for success in his/her doctoral research just through the examination of advanced coursework. While the proposed dissertation topic proposal defense still has the component of testing advanced coursework of the student, they would be more related to the student's proposed doctoral research. Thus it has the advantage in the sense that the student can be more focused on his/her research toward dissertation without having to divert his/her energy/time to unrelated coursework.

The topic proposal defense will be used as the new gateway for a student to advance to his/her Ph.D. candidacy. This is in line with the general guideline of the graduate school.

c. **Revision to Language and Research Tools requirements:** The current Department graduate catalog requires that each doctoral student must demonstrate a reading knowledge of French, German or Russian by passing a written translation exam in one of these languages conducted by the department. When the PHD-MAAP program began twenty years ago, there was still a significant amount of leading research papers and journals in the mathematical sciences that were published in French, German or Russian. The situation has dramatically changed in the past twenty years, and now the overwhelming majority of leading research papers and journals in mathematical

sciences is in English. While we do think it would still be beneficial for our doctoral graduates to have some reading knowledge of one foreign language, we believe it is no longer needed to make Foreign Language a necessary degree requirement.

The current Department graduate catalog also requires that each doctoral student must demonstrate significant computer expertise as applicable to the research or teaching in his/her major field. In recent years, all of our doctoral graduates have met this computer expertise requirement through advanced coursework, independent research projects, coursework for fulfilling the minor requirement, or dissertation research. For example, all of our doctoral students in the area of applied statistics can acquire the expertise of using the SAS and/or R software for statistical computing and analysis through their advanced coursework, and those doctoral students in the area of computational mathematics can acquire the expertise of programing languages such as C, C++ or Fortran through their doctoral research. Therefore, we believe it is no longer needed to make Research Tools a separate degree requirement either.

d. Longer-than-expected time to complete the degree: The PHD-MAAP program currently has about 45 enrolled students, among which about 35 students are supported by teaching or research assistantships. For these graduate assistants, the graduate school expects them to graduate in five years if a doctoral student does not have, or three years if the student does have, a master's degree in the same or closely related field by providing tuition and health insurance through the GASP only for a maximum of ten or six semesters, respectively. The department also has a general guideline that doctoral students are eligible for teaching assistantships for a maximum of five years.

The fact is, however, that in the past our doctoral students normally were taking longer than they were expected to graduate. For example, listed in Table I are the average years to complete the doctoral degree in the PHD-MAAP program for the past five academic years. In the past, for students who exceeded the five-year limit, the department had to provide not only continued regular assistantship but also additional support to cover students' tuition, which consequently caused significant negative impact on our ability to recruit new doctoral students for the program. We hope that, with the proposed changes, our doctoral students will be able to complete all degree requirements at least one semester sooner than needed by the current curriculum structure, and on the other hand, we believe the proposed changes can still maintain the quality of the program.

TABLE I   ANNUAL DEGREE AWARDED

ACADEMIC YEAR	DEGREE AWARDED	YEARS TO COMPLETE
2008	5	6.61
2009	4	5.85
2010	6	6.55
2011	10	5.74
2012	9	5.61

e. **Revisions needed to make the catalog more accurate:** Several places in the current catalog can be improved to accurately reflect the actual practice that has been implemented for many years in our Ph.D. program.

First, MATH 8143 and MATH 8144 are the two Program Core courses and they are required for all of our Ph.D. students, including those with focus in Statistics. But this requirement is not explicitly stated in the current version of the catalog, which often causes confusion amongst our doctoral students. Revision is made to clarify this requirement by adding "MATH 8143/8144" to the "Program of Study" section.

Second, the current Department requirement for the preliminary examination states that "The examination consists of two parts: a written examination based on Real Analysis I and II (8143-8144) and a written examination based on two other related courses chosen by the student and approved by the department Graduate Committee." Approved by the graduate school several years ago, however, for the first part of this examination we do allow our Ph.D. students with a statistics focus to take a written examination based on Probability Theory (MATH 8120) and Real Analysis I (MATH 8143) instead. Revision is made in the new "Qualifying Examination" section to explicitly spell out this option for the first part of the qualifying examination that a stat student can choose to take.

Third, the current Department requirement for the preliminary examination specifies "The student is expected to take the preliminary examination within three semesters of being admitted to the Ph.D. program." The reality is, however, that a significant portion of our Ph.D. students, in particular many of those who enter our Ph.D. program directly from a baccalaureate program, are not yet ready to take, for example, MATH 8143-8144 in their first year of being admitted to our Ph.D. program. For these students, our practice has been to advise and allow them to take Analysis I & II (MATH 5143-5144) instead in their first year, and then require them to take Real Analysis I & II in their second year (and then take the preliminary examination in the following August). Revision is also made in the new "Qualifying Examination" section to address this issue by including "After being admitted to the Ph.D. program, a student is expected to take the qualifying examination within three semesters. This time limit may be extended for up to two additional semesters in certain cases, depending on the background of the student and with program approval." in the catalog.

Finally, the course descriptions for STAT 8110-8111, cross-listed with HSRD 8110-8111, are not included in the current catalog. Revision needs to be made to include them into the catalog.

2. **Discuss prerequisites/corequisites for course(s) including class-standing, admission to the major, GPA, or other factors that would affect a student's ability to register.**

The requirements for admission to the program are not affected.

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3. **Demonstrate that course numbering is consistent with the level of academic advancement of students for whom it is intended.**

   Not applicable.

4. **In general, how will this proposal improve the scope, quality and/or efficiency of programs and/or instruction?**

   The proposed changes will make the program more efficient due to the new exam structure and the elimination of the outdated language and research tool requirements. We anticipate that the students in the program in general will be able to compete all the degree requirements one semester sooner. The proposed changes do not affect any course offerings and instructions, and hence will not affect the quality of the program.

5. **If course(s) has been offered previously under special topics numbers, give details of experience including number of times taught and enrollment figures.**

   Not applicable.

C. **IMPACT.**

1. **What group(s) of students will be served by this proposal? (Undergraduate and/or graduate; majors and/or non-majors, others?   Explain). Describe how you determine which students will be served.**

   The proposal contains only the changes to the Doctor of Philosophy Degree in Applied Mathematics program, so only the graduate students in this program will be impacted. If approved, we intend to implement the proposed changes beginning with the 2014 class.

2. **What effect will this proposal have on existing courses and curricula?**
   a. When and how often will added course(s) be taught?

   Not applicable.

   b. How will the content and/or frequency of offering of other courses be affected?

   The content and the frequency of offering of the existing graduate-level courses in the program will not be affected by this proposal.

   c. What is the anticipated enrollment in course(s) added (for credit and auditors)?

   Not applicable.

d. How will enrollment in other courses be affected? How did you determine this?

It is expected that the enrollment in the existing graduate-level courses in the program will not be noticeably affected.

e. Identify other areas of catalog copy that would be affected, including within other departments and colleges (e.g., curriculum outlines, requirements for the degree, prerequisites, articulation agreements, etc.)

The revised catalog copy can be found in **Attachment II**. Catalog entries of other programs are not affected by this proposal.

III. RESOURCES REQUIRED TO SUPPORT PROPOSAL.

A. PERSONNEL

No additional personnel required.

B. PHYSICAL FACILITY.

No additional facilities required.

C. EQUIPMENT AND SUPPLIES:

No additional equipment and supplies required.

D. COMPUTER.

No additional computer resources required.

E. AUDIO-VISUAL.

No additional audio and visual resources required.

F. OTHER RESOURCES.

No applicable

G. SOURCE OF FUNDING

No applicable

IV. CONSULTATION WITH THE LIBRARY AND OTHER DEPARTMENTS OR UNITS

A. LIBRARY CONSULTATION.

The Department consulted with the Head of Research and Information Services at the J. Murrey Atkins Library and was ensured that the present library holdings are adequate to support the proposed changes, particularly since the proposed changes will not affect the

existing research requirements. A copy of Consultation on Library Holdings can be found in **Attachment I**.

B. CONSULTATION WITH OTHER DEPARTMENTS OR UNITS

The proposal will have impacts only within the Department of Mathematics and Statistics. As such, no consultation with other departments or units is conducted.

V. INITIATION, ATTACHMENTS AND CONSIDERATION OF THE PROPOSAL

A. ORIGINATING UNIT

The Graduate Curriculum Committee, Department of Mathematics and Statistics, College of Liberal Arts and Sciences, University of North Carolina at Charlotte. The committee members, including Joel Avrin, Animikh Biswas, Yuri Godin, Doug Shafer, Yanqing Sun, and Shaozhong Deng (Graduate Coordinator), recommended this proposal on April 25, 2013.

B. CREDIT HOUR (Mandatory if new and/or revised course in proposal)

Not applicable.

C. ATTACHMENTS

1. CONSULTATION

   A copy of Consultation on Library Holdings can be found in **Attachment I**.

2. COURSE OUTLINE/SYLLABUS

   Not applicable.

3. PROPOSED CATALOG COPY

   A copy of the proposed catalog copy can be found in **Attachment II**.

4. ACADEMIC PLAN OF STUDY (UNDERGRADUATE ONLY)

   Not Applicable.

5. STUDENT LEARNING OUTCOMES (UNDERGRADUATE & GRADUATE)

   The proposed changes do not require a change in Student Learning Outcomes.

6. TEXTBOOK COSTS

   Not applicable.

Attachment I: Consultation on Library Holdings

UNCCHARLOTTE

J. Murrey Atkins Library

Consultation on Library Holdings

To: Yuanan Diao

From: Alison Bradley

Date: 10/10/13

Subject: Major Changes to PHD-MAAP Program of Study

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley   **Date:** 10/10/13

Check One:
1. Holdings are superior   _____
2. Holdings are adequate   __x__
3. Holdings are adequate only if Dept. purchases additional items.   _____
4. Holdings are inadequate   _____

Comments:
Library resources should be adequate to support the proposed changes to the Doctor of Philosophy Degree in Applied Mathematics (PhD-MAAP) Program, particularly as the proposed changes will not affect the existing research requirements. The library provides access to a wide range of relevant schalorly mateials in this area, including subscriptions to MathSciNet, Web of Science, ScienceDirect and SpringerLink for topic-based research. We have subscriptions to 151 serials related to mathematics and statistics, and over 24,000 cataloged items in the QA call number range. Additionally, students whose research requires materials not owned by our library may acquire copies with the Interlibrary Loan service.

Alison Bradley

_____
Evaluator's Signature

10/10/13

_____
Date

Attachment II: Proposed Catalog

PH.D. IN APPLIED MATHEMATICS

The Ph.D. degree program in Applied Mathematics is designed to enable its students to master a significant body of mathematics, including a specialty in applied mathematics; to relate this knowledge to a coherent area of science or engineering; and to carry on fundamental research in applied mathematics at a nationally competitive level. Recipients of this degree will, according to their abilities and choice of subspecialty, be able to work effectively in a research and development environment involving mathematical or statistical analysis and modeling in business, government or industry; to teach mathematics at the college or university level; or to carry on fundamental research in their area of specialty.

Additional Admission Requirements

In addition to the requirements of the Graduate School for admission to doctoral study, applicants must have completed at least 27 hours of courses in the mathematical sciences at the undergraduate level, as approved by the department Graduate Committee, with grades of a C or above. Admission requires that the candidate be able to take MATH 8143 or be able to take MATH 5143 and have other factors in their record that indicate ~~indicates~~ strong potential to complete the program. For prospective students who have done work in mathematics beyond the bachelor's degree, performance on that work will be considered in admission ~~admissions~~ decisions. Candidates for admission must make satisfactory scores on the general portion of the Graduate Record Examination (GRE).

Students are admitted to the program by the Graduate School, based on the recommendation of the department Graduate Committee or its designate, the Graduate Coordinator. Recommendations are based on the Committee's judgment of the candidate's ability to complete the program, as supported by the application materials. The department may waive certain requirements if it judges the candidate to be nonetheless capable of completing the program. If there are more candidates than can be accommodated, candidates are admitted in order of perceived mathematical ability, promise of success, and suitability to the program.

Program of Study

The student must complete an approved program of study, including MATH8143/8144 and a minor, typically including approximately 54 credit hours. The minor is interdisciplinary and may be satisfied by 9 hours of graduate work outside the mathematics department, by 6 credit hours for a directed project in an area of application, or by a combination of external coursework and directed project in an area of application totaling 9 credit hours.

Each student will have a dissertation an advisory committee appointed by the department Graduate Committee in consultation with the student and approved by the Dean of the Graduate SchoolDepartment Chair. It includes the prospective dissertation advisor, as well as a department co-advisor, if the dissertation advisor is not a member of the Department of Mathematics and Statistics. The dissertation advisory committee should be appointed as soon as is feasible, usually within a year after passing the Qualifying Preliminary Examination. Once formed, it will have the responsibility of constructing and approving the program of study which includes the minor. Prior to the appointment of the dissertation advisory committee the student will be advised by a graduate faculty member appointed by the department Graduate Committee.

Grades

A student is expected to achieve A's or B's in all courses included in the program of study and must have at least a 3.0 GPA to graduate. The dissertation is graded on a pass/unsatisfactory basis and, therefore, will not be included in the cumulative average. An accumulation of more than two marginal (C) grades will result in suspension of the student's enrollment in the program. If a student makes a grade of U on any course, enrollment will be suspended and the student cannot take further graduate work without being readmitted to the program. Readmission to the program requires approval of the Dean of the Graduate School upon the recommendation of the department Graduate Committee.

Transfer Credit

Only courses with grades of A or B may be accepted for transfer credit. Transfer credit must be recommended by the department Graduate Committee and approved by the Dean of the Graduate School. The amount of transfer credit cannot exceed the limit set by the Graduate School.

Qualifying Preliminary Examination

The student is expected to take the preliminary examination within three semesters of being admitted to the Ph.D. program. The examination consists of two parts: a written examination based on Real Analysis I and II (8143 8144) and a written examination based on two other related courses chosen by the student and approved by the department Graduate Committee. At the discretion of the department Graduate Committee, the student may be allowed to retake a portion of the preliminary examination a second time if the student does not pass that portion on the first attempt. A student who does not complete the preliminary examination after two attempts is terminated from the Ph.D. program.

After being admitted to the Ph.D. program, a student is expected to take the qualifying examination within three semesters. This time limit may be extended for up to two additional semesters in certain cases, depending on the background of the student and with program approval. The qualifying examination consists of two parts: the first part is a written examination based on Real Analysis I and II (MATH 8143-MATH 8144) or Probability Theory I and Real Analysis I (MATH 8120-MATH 8143), the latter intended for a student with a statistics focus.

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The second part is a written examination based on two other courses chosen by the student to be specifically related to the student's intended specialty and approved by the department Graduate Committee. The student may be allowed to retake a portion of the qualifying examination a second time if the student does not pass that portion on the first attempt within the guidelines of the Graduate School regulations pertaining to the qualifying examination and as overseen by the department Graduate Committee. A student who does not complete the qualifying examination as per the regulations of the Graduate School is terminated from the Ph.D. program.

Qualifying Examination and Admission to Candidacy

Each student must pass a comprehensive oral examination covering her/his chosen field of research and related advanced coursework. The exam is conducted by the student's Advisory Committee and may include an additional written examination. The exam is open to the graduate faculty of the department. The student is expected to take the qualifying examination within two years of the appointment of the student's Advisory Committee. A student who fails the qualifying examination twice is terminated from the Ph.D. program. The dissertation topic may be proposed after the student has passed the qualifying examination. A doctoral student advances to candidacy after the dissertation topic has been approved by the student's advisory committee and the Dean of the Graduate School.

Topic Approval Defense and Admission to Candidacy

After the student completes the qualifying examination and advanced coursework deemed necessary for the student's research as approved by the student's doctoral dissertation committee, the student, in consultation with the student's dissertation advisor, may propose a dissertation topic. The dissertation topic proposal must be articulated and defended at a meeting of the student's dissertation committee. A written dissertation proposal must be submitted to the dissertation committee at least two weeks prior to the scheduled defense. The student is expected during the course of the topic defense to outline and demonstrate sufficient proficiency with the advanced knowledge and techniques to be used in the conduct of the research. The topic approval defense and the committee's deliberations in this regard are to be conducted according to the pertinent regulations of the Graduate School. A doctoral student advances to candidacy after the student's dissertation committee and the Dean of the Graduate School have approved the dissertation topic proposal.

Assistantships

A number of graduate assistantships are available each year (with nationally-competitive stipends) for qualified applicants. A limited number of fellowship awards can be applied to supplement these stipends or provide stand-alone stipends for up to $25,000 for especially qualified students.

Dissertation

The student must complete and defend a dissertation based on a research program approved by the student's dissertation advisor which results in a high quality, original and substantial piece of research. The student must orally present and successfully defend the dissertation before the student's doctoral dissertation committee ~~Advisory Committee~~ in a defense that is open to the public. A copy of the dissertation must be made available to the graduate faculty of the department at least two weeks prior to the public defense. The dissertation will be graded on a pass/unsatisfactory basis by the dissertation committee ~~Advisory Committee~~ and must be approved by the Department Graduate Coordinator and the Dean of the Graduate School.

Residency Requirement

The full-time Ph.D. student must enroll for one continuous full-time year (i.e., two consecutive semesters of at least nine graduate credit hours in each semester) following admission to the program.

~~Language and Research Tool Requirements~~

~~Each student must demonstrate a reading knowledge of French, German or Russian by passing a written translation exam in one of these languages conducted by the Mathematics Department. In addition, the student must demonstrate significant computer expertise applicable to research or teaching in his or her major field as approved by the student's Advisory Committee. The computer expertise requirement may include coursework or work on a project and may overlap with the minor requirement.~~

Time Limit for Degree Completion

The student must achieve admission to candidacy within six years after admission to the program and complete all requirements within six years after admission to candidacy for the Ph.D. degree. All requirements for the degree must be completed within eight years after first registration as a doctoral student.

COURSES IN MATHEMATICS, MATHEMATICS EDUCATION, OPERATIONS RESEARCH, AND STATISTICS

Mathematics (MATH)

……

MATH 8050. Topics in Mathematics. (2-3) See MATH 7050 ~~7071~~ for Course Description.
……

MATH 8144. Real Analysis II. (3) See MATH 7144 ~~7147~~ for Course Description.
……

MATH 8275. Dynamical Systems I. (3) See MATH 7275 ~~7276~~ for Course Description.
……

Statistics (STAT)

STAT 8110. Applied Biostatistics: Regression. (3) See HSRD 8110 for Course Description.

STAT 8111. Applied Biostatistics: Multivariate Methods. (3) See HSRD 8111 for Course Description.